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Original Article

Peritoneal Dialysis in Morocco: Nineteen Years of Experience from the First National Center and Evaluation of Technique Survival and Mortality

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Abstract

Background and aims: Peritoneal dialysis (PD) remains underused despite being a valid alternative to hemodialysis. This study assessed patients' clinical profiles, technique survival, and mortality at Morocco's first PD center.

Methods: This retrospective study evaluated 247 patients treated with PD from June 2006 to May 2025, with no exclusions. Required data were obtained from the French-language PD Registry and medical records. Finally, t-tests, ANOVA, chi-square tests, and stepwise backward logistic regression were used for statistical analysis ($P<0.05$).

Results: Overall, 233 (94.3%) patients chose PD as their renal replacement therapy (RRT). The average age was 47.5±17.3 years. In addition, 62.7% were male, and 25.4% had diabetes. The median follow-up period was 4.0 years, with an interquartile range of 2.0–7.0. Technique survival rates at 1, 3, and 5 years were 90%, 55%, and 45%, respectively. In addition, patient survival rates were 88%, 65%, and 50%. The incidence of peritonitis was 0.48 episodes per patient-year and was the primary cause of technique failure (53.6%) and contributed to 11.9% of deaths. Logistic regression demonstrated a technique failure associated with diabetes ($P=0.038$). Mortality was linked to age>60 ($P=0.022$), vascular access failure ($P=0.013$), and assisted PD ($P=0.003$). Hypoalbuminemia ($P=0.281$), anemia ($P=0.176$), and hypophosphatemia ($P=0.223$) were not significant.

Conclusion: PD is a long-term RRT in Morocco. Mortality is linked to advanced age, vascular access failure, and assisted PD. Continued patient education and staff training are vital.

Keywords: Peritoneal dialysis, Peritonitis, Mortality, Technique failure

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Introduction

The incidence of end-stage kidney disease (ESKD) is steadily increasing, affecting people of all ages and genders without discrimination.[1] Three methods of renal replacement therapy are available to compensate for kidney failure. Globally, hemodialysis (HD) remains the predominant treatment modality for ESKD.[2,3] Likewise, PD is considered a complementary and non-competitive technique to HD and kidney transplantation.[4]

Although less frequently proposed (likely due to limited awareness and therapeutic education), peritoneal dialysis (PD) has demonstrated lower mortality rates than HD during the first two years.[5]

In Morocco, HD is the main treatment modality. Moreover, due to difficulties in obtaining family consent for organ donation, only a limited number of patients on the national kidney transplant waiting list are transplanted each year.[6,7] PD is a more recently introduced technique and remains less widely practiced. It was first used in Morocco in 2006. This modality has proven effective and well-tolerated, particularly among patients at age extremes and professionally active.[8,9]

Patient survival rates on PD over five years vary from 42% to 64% worldwide.[10–14] However, few studies have evaluated outcomes for patients on PD beyond five years and up to ten years.[14–16] The improved life expectancy of dialysis patients has significant implications for patients and healthcare providers.

Our study aims to analyze demographic, clinical, biological, and outcomes, and to determine technique survival and patient survival in a 19-year experience at the first PD center in Morocco.

Materials and Methods

Selection and Description of Participants

The PD unit has been in operation for 19 years, beginning in June 2006 and continuing through May 2025. The study included all patients undergoing PD registered in the French-language PD Registry. All patients treated with PD during this period were included in the study. The required data were collected from the French-language PD Registry and the individual medical records

of each patient.

Studied Variables

The variables investigated in this study were demographic data, social factors, intellectual level, clinical data, complications, and outcomes. Demographic data included gender, age at the initiation of PD, and geographic origin of the patients. In addition, social factors consisted of socioeconomic status, employment status, and the need for assistance during dialysis exchanges. Further, educational attainment was categorized into university level, secondary level, primary level, and illiteracy. Moreover, clinical data encompassed the underlying nephropathy, Charlson comorbidity index, diabetes, ischemic heart disease, hypertension (defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg), and abdominal hernia. Other recorded clinical data included any history of HD or kidney transplantation before PD initiation, body mass index, urine output, and estimated glomerular filtration rate at the start of PD. Additionally, documented PD-related complications were divided into mechanical and infectious categories. The first category consisted of catheter dysfunction, catheter migration, peritoneal fluid leaks, and catheter perforation. In addition, the second one included exit-site infections, tunnel infections, and the rate of peritonitis (expressed as patient-months/peritonitis and peritonitis/patient-years). The outcomes encompassed primary (survival using the PD technique) and secondary (reasons for catheter removal, causes of technique failure defined as permanent transfer to HD, and causes of death) groups.

Statistical Analysis

All quantitative variables were expressed as means ± standard deviations or medians with an interquartile range. Qualitative variables were presented as frequencies and percentages. Statistical comparisons were made using Student's t-test or analysis of variance for continuous variables and chi-square or binomial tests for categorical variables.

A P value < 0.05 was considered statistically significant. The obtained data were analyzed using Jamovi software, version 2.3.21.

Ethical Approval

Our institution did not require the formal approval of the ethics committee for retrospective studies using anonymized data. The research was conducted based on institutional policies and ethical standards consistent with national and international guidelines. In addition, oral consent was obtained from all patients in our center for using their medical data.

Results

Patient Characteristics

Overall, 247 patients with ESKD were enrolled in our center between June 2006 and May 2025 (Figure 1). Among them, 8 (3.3%) had a kidney transplant, and 67 (27.4%) were on chronic HD. The remaining ESKD patients were recruited through the therapeutic education program, based on their informed choice of renal replacement therapy modality. Lower recruitment was observed between 2010 and 2013, as only one nurse was available for PD. In contrast, a peak in patient recruitment was noted starting in 2014, when two nurses were consistently assigned. On the other hand, a significant decline in patient recruitment was found during the coronavirus disease 2019 (COVID-19) pandemic, particularly between 2019 and 2020.

While most patients resided near the country's center and were close to our PD unit (red pin), some came from distances exceeding 200 km due to the lack of a PD facility in their region (Figure 2).

The mean age of our population was 47.5 ± 17.3 years, with age extremes ranging from 11 to 85 years and a slight male predominance (male:female ratio of 1.26. Approximately 62.7% of the patients had a good

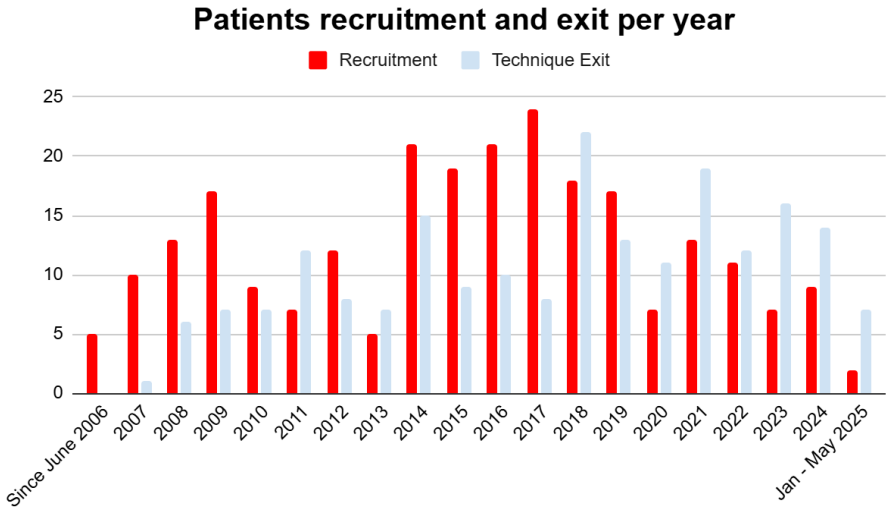

Figure 1. Patient Recruitment and Exits Per Year. *Note.* *Jan: January

Figure 2. National Geographic Distribution* of Patients Attending Our Peritoneal Dialysis Center, Morocco. *Note*. *Black dots

socioeconomic level. Professionally, 62.5% out of 82.7% of educated patients had a professional activity in various fields, while 38.5% had significantly more free time, mainly represented by retirees and homemakers.

Diabetic nephropathy was the leading cause of ESKD in 60 (24.5%) patients, followed by chronic glomerulonephritis in 47 (18.4%) patients. In comparison, polycystic kidney disease was found to be the cause of ESKD in 15 (6.1%) patients.

The personal choice of PD as a replacement therapy was the predominant indication in 233 (94%) patients, whereas 14 (6%) patients had vascular access failure. Among these patients, 204 (82%) were autonomous and required no family assistance for PD exchanges. The peritoneal equilibration test was performed on 79 patients (57 fast transporters and 22 slow transporters). The median follow-up time was 4.0 years (interquartile range: 2.0–7.0).

The baseline characteristics at the initiation of dialysis for all patients are presented in Table 1.

Table 1. Demographic and Clinical Characteristics at the Initiation of Peritoneal Dialysis

Characteristics	Patients (N = 247, 100%)
Age at the start of PD (year)	47.5 ± 17.3
<20	18 (7)
20–60	173 (70)
>60	56 (22.9)
Level of education	
Illiteracy	41 (16.8)
Primary school	19 (7.8)
Middle school	38 (14.3)
High school	32 (13)
University and beyond	117 (48)
Occupational activity	
Finance and administration	67 (27)
Service and sales	41 (16.4)
Education and the arts	28 (11.5)
Medicine and healthcare	16 (6.6)
Unemployed and retired	95 (38.5)
Medical history and comorbidities	
Diabetes	62 (25.4)
Hypertension	140 (57.4)
Ischemic heart disease	73 (30)
Presence of an abdominal hernia	19 (7.7)
History of previous chronic hemodialysis	67 (27)
History of prior kidney transplantation	8 (3.3)
Initial nephropathy	
Glomerulonephritis	47 (18.4)
PKD	15 (6,1)
Diabetic nephropathy	60 (24.5)
Tubulo-interstitial nephropathy	36 (14.75)
Nephroangiosclerosis	25 (9,4)
Unspecified nephropathy	66 (27)
Charlson comorbidity index	2 [2-3]
BMI (kg/m²)	24 ± 5.02
24-hour urine output (mL) at the initiation of PD	1500 (1150–2000)
eGFR (mL/min) at the initiation of PD	6.10 (4.27–8.98)

Note. PD: Peritoneal dialysis; PKD: Polycystic kidney disease; BMI: Body mass index; eGFR: Estimated glomerular filtration rate.

Peritoneal Dialysis Survival and Patient Outcomes

Peritoneal Dialysis-Technique Survival

During the follow-up, 97 (39.2%) patients were transferred to HD, 23 (9.3%) patients received a kidney transplant, 60 (24.3%) patients were still in PD, and 67 (27.1%) patients died.

The median overall survival in PD was 4 years (Figure 3). Technique survival rates were 90%, 55%, 45%, 25%, and 5%, respectively, at 1 year, 3 years, 5 years, 8 years, and 10 years. The median technique survival, excluding deaths, was 8 years (Figure 3).

PD was frequently discontinued due to peritonitis (53.6%). The overall peritonitis rate was 0.48 episodes per patient-year, with a peritonitis incidence of one episode every 24.8 months per patient (Figure 4). Other causes included loss of ultrafiltration (10.3%) and catheter dysfunction (6.2%), while peritoneal leaks appeared to be less frequent causes of technique failure (5.1%). However, psychosocial factors were not negligible, as they were the reason for PD discontinuation in 19 patients (19.6%).

In logistic regression analysis, vascular access issues ($P = 0.034$) and assisted PD ($P = 0.027$) were not associated with a risk of technique failure, while diabetes ($P = 0.038$) was found to be related to technique failure in our population.

Peritoneal Dialysis-Related Mortality

In general, 67 (27%) patients died in our study. Patient survival rates were 88%, 65%, 50%, 15%, and 10% at 1 year, 3 years, 5 years, 8 years, and 10 years, respectively. Based on the results, the mortality rate increased after 3 years of dialysis, while the technique failure rate demonstrated an increase after 4 years.

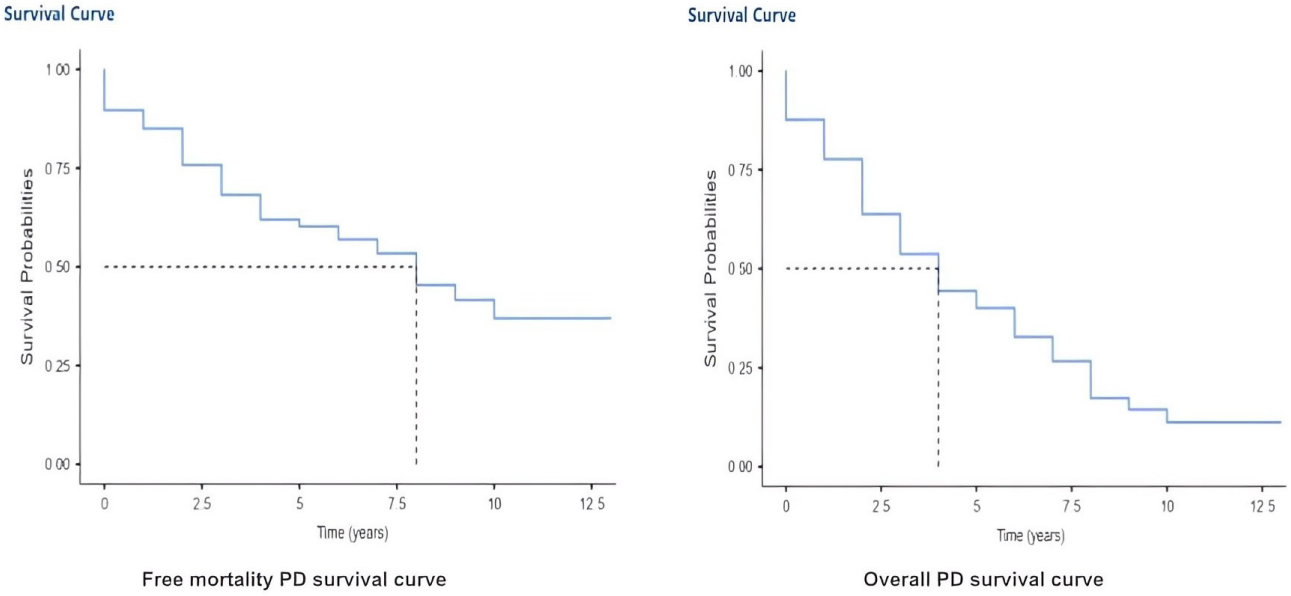

Figure 3. PD Survival Curves. *Note*. PD: Peritoneal dialysis

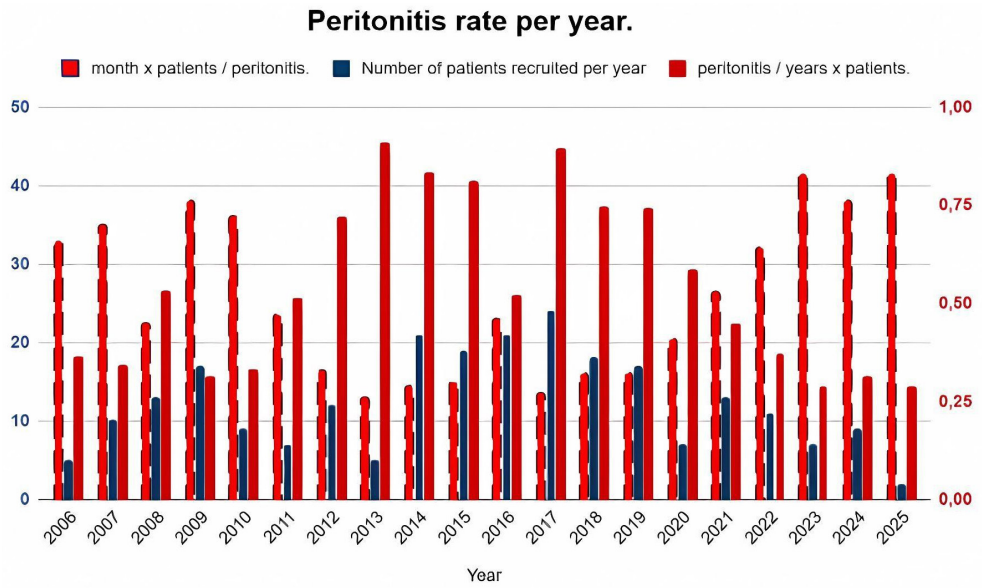

Figure 4. Peritonitis Rate Per Year

Cardiovascular and infectious causes accounted for more than 50% and 43.3% of the deaths (34 patients), respectively. They included peritonitis (n = 8, 11.9%) caused mainly by *Staphylococcus aureus* and coagulase-negative staphylococci, COVID-19 infection (n = 4, 5.9%), and sepsis (n = 17, 25.3%). Figure 4 shows the annual peritonitis rates since the opening of our center. Only one case of hemorrhagic shock due to graft necrosis was observed, in addition to a single case of respiratory distress.

In logistic regression analysis, age over 60 years ($P < 0.001$), ischemic heart disease ($P = 0.016$), diabetes ($P < 0.001$), vascular access issues ($P = 0.003$), assisted peritoneal dialysis ($P < 0.001$), and a Charlson comorbidity index greater than 2 ($P < 0.001$) were associated with mortality. Conversely, no significant association with mortality was observed for serum albumin levels below 30 g/L ($P = 0.281$), hemoglobin levels below 9 g/dL ($P = 0.176$), or hypophosphatemia defined as phosphate levels below 0.8 mmol/L ($P = 0.223$).

Discussion

PD is still second after HD as an extrarenal purification method worldwide. Approximately 196,000 patients were globally treated with PD in 2008, representing 11% of the dialysis population.[17] The underutilization of PD is largely attributable to limited knowledge among both patients and physicians concerning renal replacement techniques. To address this issue, a well-established therapeutic education program aims to present dialysis techniques while allowing patients to choose the method based on their preferences and medical indications.

In our study, based on consultations dedicated to chronic kidney disease and word of mouth, 94% of patients chose PD as their replacement therapy method. This figure is extremely high compared to the global prevalence of PD [18]. Among them, 27.4% were on chronic HD and wished to switch to PD, while 3.3% were kidney transplant recipients who experienced graft rejection.

Indeed, the diversity of our patients proved that PD is suitable for any patient, regardless of gender, age, socioeconomic status, or education level. Our results demonstrated a male predominance, with the majority of patients of working age (between 20 years and 60 years), most of whom had a good socioeconomic level. Half of our patients had completed university studies, and 38.5% were unemployed, giving them much free time.

As expected, diabetic nephropathy represented the predominant initial nephropathy, followed by glomerular nephropathy. Due to the small sample size, the peritoneal transport status had no significant impact on technique failure or mortality in our study.

Peritonitis remains a serious complication and a major cause of mortality and technique failure in PD.[19] Its prevalence and etiology vary across regions and periods. Recent guidelines recommend defining treatment based on local ecology.[19]

In our case, the annual peritonitis rate was highly variable in the early years of the center's establishment, likely due to the large number of patients being recruited. However, a significant decrease was observed in the peritonitis rate starting from COVID-19, which conforms to several studies that analyzed the impact of COVID-19 on the incidence of peritonitis.[18–22]

This is likely due to the strict measures taken by patients, fearing hospital visits for mechanical or infectious issues, as well as the establishment of close contact via telemedicine with doctors and nurses in the PD unit. This contact continued during the following years in addition to quarterly consultations.

Staphylococcus aureus and coagulase-negative staphylococci remain the leading causes of peritonitis.[22–24] Nevertheless, peritonitis was the cause of technique failure in 53.6% of cases in our study, which is consistent with international cohorts,[25] especially when it involves refractory peritonitis or fungal peritonitis, where catheter reinsertion is impossible due to adhesion development.[26] However, peritonitis accounted for only 11.9% of deaths in our cohort, ranking third after cardiovascular events and sepsis unrelated to PD, which is in line with the findings of previous studies.[26,27]

The survival rate of patients in our center was similar to that described in international literature.[26–31] Some well-established predictors of mortality (e.g., diabetes,[29] population aging,[32-33] comorbidities,[29] and vascular access problems.[33-34]

Exposure to the months or years of HD, in addition to traditional risk factors, most likely negatively impacted well-established risk factors, such as residual renal function and chronic inflammation. However, previous HD was not significantly associated with mortality or technique failure in this study, except in cases of vascular access problems, which are significantly associated with mortality but not technique failure.

Conclusion

This 19-year experience confirms that PD is a viable and sustainable treatment option in Morocco. This technique offers an attractive choice for any patient interested in maintaining independence and an active lifestyle. Patient education supports the continued and growing use of this technique.

The significant variability of patients and their comorbidities, especially those without vascular access, requires special attention to prolong their survival. However, several studies have proven that retraining medical staff and patients improves the technique's survival.

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Authors' Contribution

Conceptualization: Nabil Hmaidouch, Nada El Kadiri.
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Investigation: Nabil Hmaidouch, Nada El Kadiri, Selim Benhadda.
Methodology: Nabil Hmaidouch, Nada El Kadiri, Loubna Benamar.
Project administration: Nabil Hmaidouch, Naima Ouzeddoun, Loubna Benamar.
Resources: Nabil Hmaidouch, Loubna Benamar.
Software: Nabil Hmaidouch, Selim Benhadda.
Supervision: Nada El Kadiri, Loubna Benamar.
Validation: Nabil Hmaidouch, Naima Ouzeddoun, Loubna Benamar.
Visualization: Nabil Hmaidouch, Nada El Kadiri.
Writing–original draft: Nabil Hmaidouch.
Writing–review & editing: Nabil Hmaidouch, Nada El Kadiri, Loubna Benamar.

Competing Interests

The authors declare no conflict of interests.

Ethical Approval

This retrospective study required no ethical approval from our institution. Nonetheless, all patients provided oral and written informed consent prior to data collection.

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